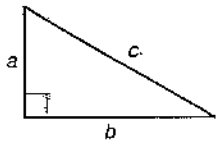
Name _____ Date _____ Class _____

LESSON 5-7

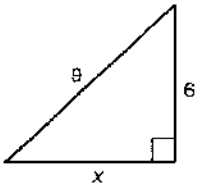
The Pythagorean Theorem

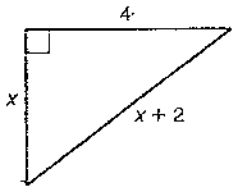
The **Pythagorean Theorem** states that the following relationship exists among the lengths of the legs, a and b, and the length of the hypotenuse, c, of any right triangle.



$$a^2 + b^2 = c^2$$

Use the Pythagorean Theorem to find the value of x in each triangle.

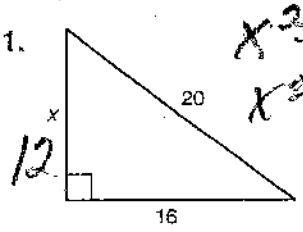




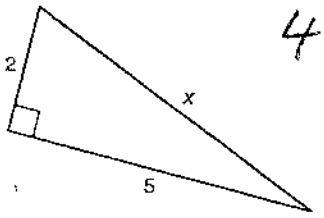
$a^2 + b^2 = c^2$	Pythagorean Theorem	$a^2 + b^2 = c^2$
$x^2 + 6^2 = 9^2$	Substitute.	$x^2 + 4^2 = (x + 2)^2$
$x^2 + 36 = 81$	Take the squares.	$x^2 + 16 = x^2 + 4x + 4$
$x^2 = 45$	Simplify.	$4x = 12$
$x = \sqrt{45}$	Take the positive square root and simplify.	$x = 3$
$x = 3\sqrt{5}$		

Find the value of x. Give your answer in simplest radical form.

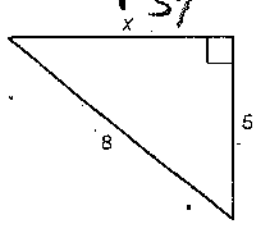
1. $x^2+16^2=20^2$ $x^2+256=400$ $x^2=144$ $\sqrt{x^2}=\sqrt{144}$ $x=12$



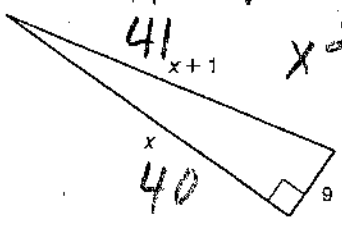
2. $2^2+5^2=x^2$ $4+25=x^2$ $29=x^2$ $x=\sqrt{29}$



3. $\sqrt{39}$ $x^2+5^2=8^2$ $x^2+25=64$ $x^2=39$ $x=\sqrt{39}$



4. $x^2+9^2=(x+1)^2$ $(x+1)(x+1)$ x^2+2x+1 $x^2+81=x^2+2x+1$ $81=2x+1$ $80=2x$ $x=40$



Name KEY Date _____ Class _____

LESSON 5-7

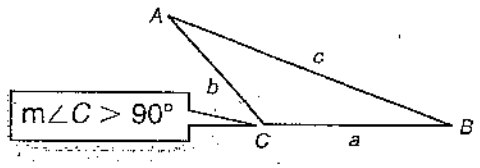
The Pythagorean Theorem continued

A **Pythagorean triple** is a set of three nonzero whole numbers a, b, and c that satisfy the equation $a^2 + b^2 = c^2$.

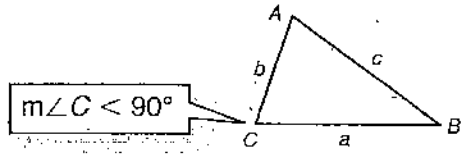
Pythagorean Triples	Not Pythagorean Triples
3, 4, 5, 5, 12, 13	2, 3, 4 6, 9, $\sqrt{117}$

You can use the following theorem to classify triangles by their angles if you know their side lengths. Always use the length of the longest side for c.

Pythagorean Inequalities Theorem



If $c^2 > a^2 + b^2$, then $\triangle ABC$ is obtuse.

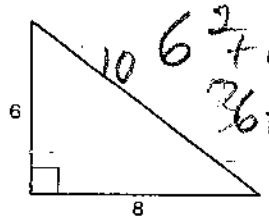


If $c^2 < a^2 + b^2$, then $\triangle ABC$ is acute.

Consider the measures 2, 5, and 6. They can be the side lengths of a triangle since $2 + 5 > 6$, $2 + 6 > 5$, and $5 + 6 > 2$. If you substitute the values into $c^2 \stackrel{?}{=} a^2 + b^2$, you get $36 > 29$. Since $c^2 > a^2 + b^2$, a triangle with side lengths 2, 5, and 6 must be obtuse.

Find the missing side length. Tell whether the side lengths form a Pythagorean triple. Explain.

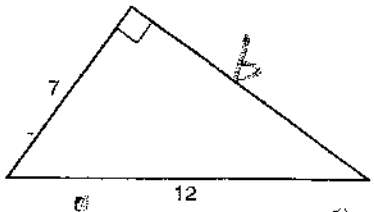
5.



$6^2 + 8^2 = c^2$
$36 + 64 = c^2$
$100 = c^2$
$c = 10$

Yes
Pythagorean Triple

6.



$7^2 + b^2 = 12^2$
$49 + b^2 = 144$
$b^2 = 95$ $b = \sqrt{95}$

Tell whether the measures can be the side lengths of a triangle. If so, classify the triangle as acute, obtuse, or right.

7. 4, 7, 9
9^2 $4^2 + 7^2$
81 16 + 49
$81 > 65$
Obtuse Δ

8. 10, 13, 16
16^2 $10^2 + 13^2$
256 100 + 169
$256 < 269$
Acute Δ

9. 8, 8, 11
11^2 $8^2 + 8^2$
121 64 + 64
$121 < 128$
Acute Δ

10. 9, 12, 15
15^2 $9^2 + 12^2$
$225 = 81 + 144$
$225 = 225$
Right Δ

11. 5, 14, 20
20^2 $5^2 + 14^2$
400 25 + 196
$400 > 221$
Obtuse Δ

12. 4.5, 6, 10.2
10.2^2 $6^2 + 4.5^2$
104.04 36 + 20.25
$104.04 > 56.25$
Obtuse Δ

Key

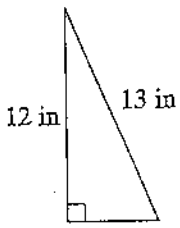
Name _____

The Pythagorean Theorem and Its Converse

Date _____ Period ____

Find the missing side of each triangle. Round your answers to the nearest tenth if necessary.

1)



$a^2+b^2=c^2$

The hypotenuse is c

$12^2+b^2=13^2$

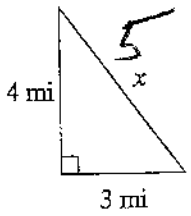
$144+b^2=169$

$b^2=25$

$\sqrt{b^2}=\sqrt{25}$

$b=5$

2)



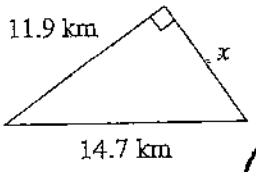
$3^2+4^2=x^2$

$9+16=x^2$

$25=x^2$

$x=5$

3)



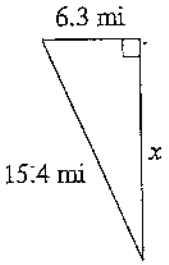
$(11.9)^2+b^2=(14.7)^2$

$141.61+b^2=216.09$

$b^2=74.48$

$b=8.6$

4)



$6.3^2+x^2=15.4^2$

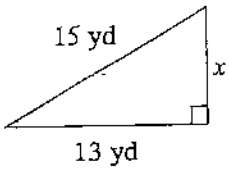
$39.69+x^2=237.16$

$x^2=197.47$

$x=14.1$

Find the missing side of each triangle. Leave your answers in simplest radical form.

5)



$13^2+b^2=15^2$

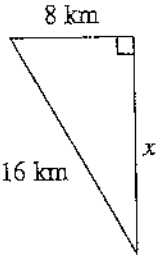
$169+b^2=225$

$b^2=56$

$b=\sqrt{4}\sqrt{14}$

$b=2\sqrt{14}$

6)



$8^2+x^2=16^2$

$64+x^2=256$

$x^2=192$

$x=\sqrt{64}\sqrt{3}$

$x=8\sqrt{3}$

Find the missing side of each right triangle. Side *c* is the hypotenuse. Sides *a* and *b* are the legs. Leave your answers in simplest radical form.

7) $a=11$ m, $c=15$ m

$11^2+b^2=15^2$

$121+b^2=225$

$b^2=104$

$b=\sqrt{4}\sqrt{26}=2\sqrt{26}$

8) $b=\sqrt{6}$ yd, $c=4$ yd

$a^2+(\sqrt{6})^2=4^2$

$a^2+6=16$

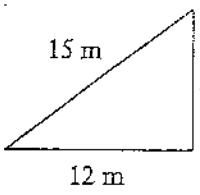
$a^2=10$

$a=\sqrt{10}$

KEY

State if each triangle is a right triangle.

9)



$a^2+b^2=c^2$

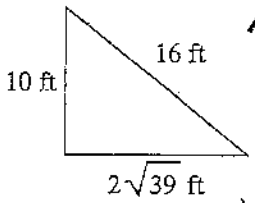
$9^2+12^2=15^2$

$81+144=225$

$225=225$

The △ is a ◺

10)



$10^2+(2\sqrt{39})^2=16^2$

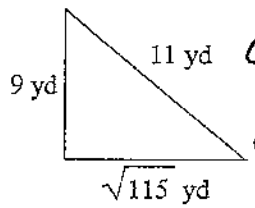
$100+4(39)=256$

$100+156=256$

$256=256$

Yes ◺

11)



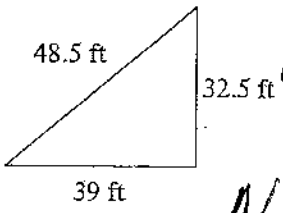
$9^2+(\sqrt{115})^2=11^2$

$81+115=121$

$196 \neq 121$

The △ is not a ◺

12)



$32.5^2+39^2=48.5^2$

$1056.25+1521=2352.25$

$2577.25>2352.25$

Acute △

No, Not a ◺

State if the three sides lengths form a right triangle.

13) 10 cm, 49.5 cm, 50.5 cm

Yes, ◺

$10^2+(49.5)^2=(50.5)^2$

$100+2450.25=2550.25$

$2550.25=2550.25$

14) 9 in, 12 in, 15 in

$9^2+12^2=15^2$

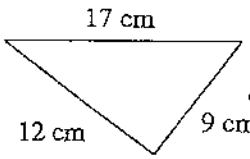
$81+144=225$

$225=225$

Yes, ◺

State if each triangle is acute, obtuse, or right.

15)



17^2 12^2+9^2

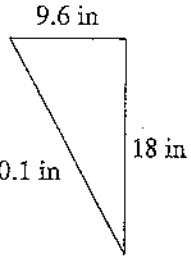
289 $144+81$

$289>225$

$c^2>a^2+b^2$

The △ is obtuse

16)



$9.6^2+18^2=20.1^2$

$92.16+324=404.01$

$416.16>404.01$

It is Acute

No, Not a ◺

State if the three side lengths form an acute, obtuse, or right triangle.

17) 6 mi, $2\sqrt{55}$ mi, 17 mi

17^2 6^2 $(2\sqrt{55})^2$

289 36 $4(55)$

$36+220$

$289>256$

$c^2>a^2+b^2$

The △ is Obtuse

18) 4.8 km, 28.6 km, 29 km

$4.8^2+28.6^2=29^2$

$23.04+817.96=841$

$841=841$

Yes, ◺